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Interactive comment on "WAVETRISK-1.0: an adaptive wavelet hydrostatic dynamical core" *by* Nicholas K.-R. Kevlahan and Thomas Dubos

Anonymous Referee #1

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This manuscript describes the elements used to build a wavelet-adaptive, global, hydrostatic atmospheric model. The numerical scheme is based on a previous, non-adaptive version of the model and is only described briefly in the manuscript. The main ingredients required to make this model wavelet-adaptive are discussed: including important aspects such as conservation of quantities during interpolations between refinement levels. The hexagonal/icosahedral grid structure is presented also in the context of wavelets and general details on the implementation and parallel scheme are given. The algorithm and criteria used for adaptive refinement are presented, including a discussion and analysis of trend- versus solution-based criteria. Validation and performance tests are then conducted, including idealised cases and a more complete, climate-scale Held-Suarez circulation model.

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I found the manuscript clearly and carefully written. The results presented are important as they constitute one of the first demonstrations of adaptivity for three-dimensional climate-scale models.

My main reservation regards the amount of details given for the performance of the model. The authors choose to give only relative performance data, either comparing the code with itself or with its previous non-adaptive incarnation, dynamico. Absolute performance should also be given: in particular, the number of integration timesteps, the wall-clock time and some details on the system on which the tests were run (CPU type, memory etc.) must be added for each of the cases.

Further comments on this and other more minor points follow:

* The order of the method is not clearly discussed. I assume it is spatially second-order. Some discussion on possible extensions to higher order should also be included.

* p.2 line 25: "To the best of our knowledge, no previous work has developed and evaluated AMR for complex three-dimensional atmospheric flows." This statement is too broad. There are many earlier references for adaptive three-dimensional atmospheric flows. By "atmospheric", the authors probably mean "global-scale atmospheric" flows. Also, as pointed out in one of the readers' comments, Popinet presented results of an adaptive Held-Suarez model at the "Multiscale Numerics of the Atmosphere and Ocean" Newton Institute program back in 2012.

* p.2 line 30: "However they do not find any "clear strategy for establishing the best general refinement criteria." In contrast, wavetrisk uses objective and clearly defined refinement criteria which control the multiscale relative error of the solution or of its tendencies as measured directly by the wavelet coefficients." Again, here the authors claim too much. The approach presented later in the paper is useful and interesting however it cannot really be said to be a "clear strategy for establishing the best general refinement criteria." Indeed, finding such a strategy is a tall order and has been the topic of numerous publications (and even entire conferences) dealing with "Uncertainty

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Quantification".

* Figure 4: Although "speedup curves" are a standard representation, they are a particularly poor way of characterising (parallel) performance. This should be replaced with a figure showing the "speed" or "computational time" per processing unit as a function of the number of processing units. Perfect scaling is then a constant and the value of this constant gives the absolute performance. This thus shows two important values (absolute speed and scalability) instead of one (scalability) and is immune to many of the biases of the "speedup curve" representation.

* p. 3 Section 4 typo: "applies the principle of wavelet-based adaptivity to present the context."

* p.7 line 13. typo "Note that the primal grid of triangles remains nested on the sphere, which means that the restrictions of velocity, Bernoulli and circulation and straightforward."

* p. 8 line 22: "To remedy this we use a simple rebalancing algorithm to redistribute sub-domains amongst the cores to produce a more balanced load. This rebalancing is done at each checkpoint save." This is an extremely short description of a non-trivial and important algorithm. More details should be given and/or appropriate references given.

* Algorithm 1, typo: "at all vertical levels so final adapted grid is union of adapted grids over all vertical levels."

* p.16 line 7, typo: "on the cost of the multiscale runes"

* p. 24 line 3. typo: "The Held–Suarez general circulation experiment adds a qualitatively new aspect the Rossby wave and baroclinic instability tests we considered above:"

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